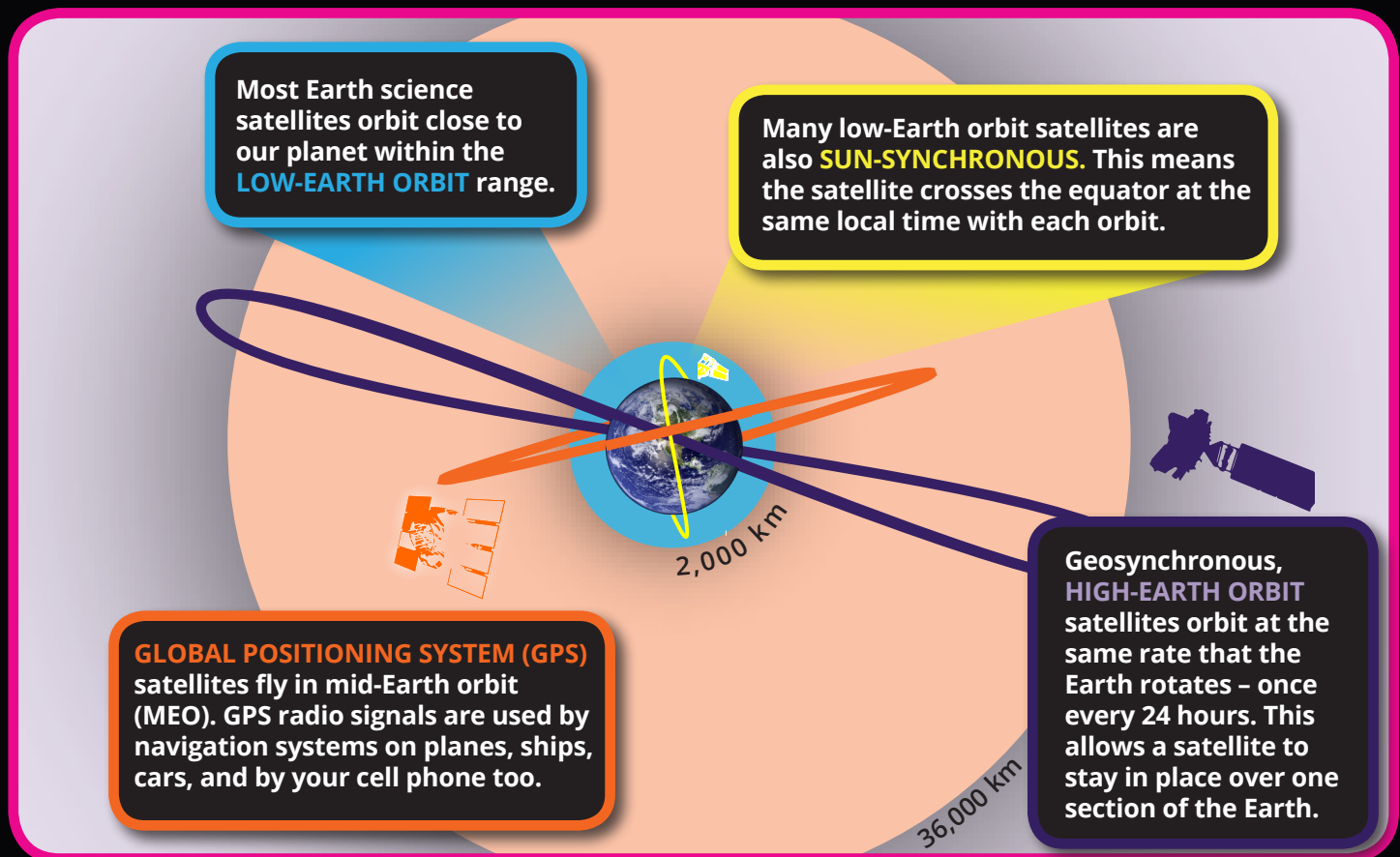


# A Place in Space

## Earth's Orbits

If you could pick any seat at a basketball game, which would you pick? Do you want to zero in on a particular player? Sit up close. If slam dunks are your thing, then snag a spot near the basket. But if you would rather see plays unfolding across the court, sit higher in the arena.

**Satellites** are positioned to see our planet from different perspectives, too. These positions are called **orbits**. Orbits can be close up or far away. The angle of a satellite's orbit also plays a part in what it can "see."



### Vocabulary

**orbit** – The curved path of an object that continuously goes around another object.

**satellite** – An object that is in orbit around another object. There are natural satellites (moons) and artificial ones (like NASA's Earth observing fleet).



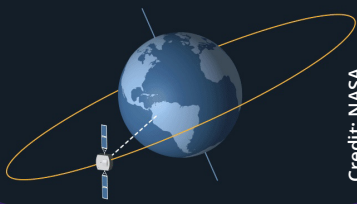
# Each Satellite Has a Job To Do

The Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) travels within the low-Earth orbit range and uses laser pulses to measure ice and snow. With an orbit angle of 92 degrees from the equator, it is perfect for passing very close to the icy Poles.

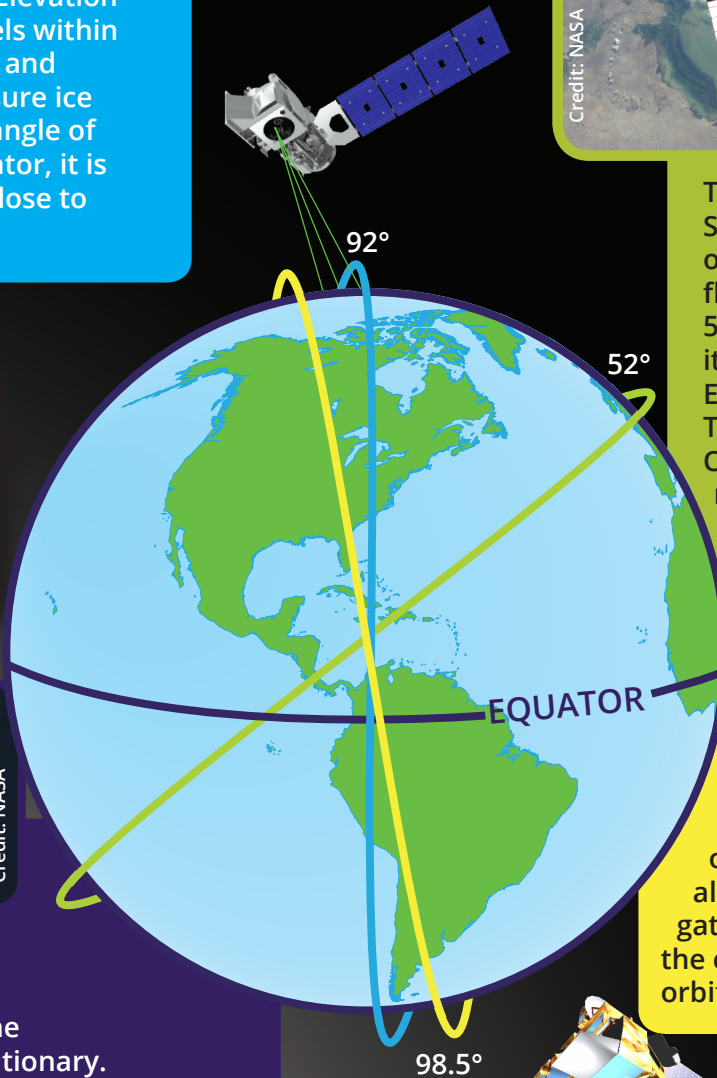
## Vocabulary



**latitude** – The position of an object, measured in degrees north or south of the equator.

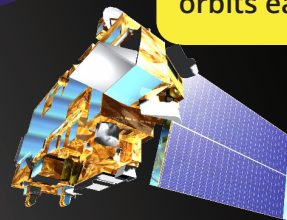


If a satellite in geosynchronous orbit is positioned directly over the equator, it is called geostationary. The Geostationary Operational Environmental Satellite-16 (GOES-16) uses this orbit to stay fixed over the Western Hemisphere. There it can monitor weather events such as hurricanes.



The International Space Station is a low-Earth orbiting satellite that flies between 52°N and 52°S latitude. This allows it to pass over 90% of Earth's populated cities. The Orbiting Carbon Observatory 3 (OCO-3) is mounted on the ISS. It measures carbon dioxide while flying over Earth's urban areas.

The Sun-synchronous Terra satellite orbits Earth at an angle of 98.5 degrees. This allows the satellite to gather data from across the entire globe in about 15 orbits each day.



## By the Numbers



**1<sup>st</sup>** Sputnik was the first satellite sent into orbit around the Earth. It launched in 1957.

**3** How many geostationary satellites it takes to create a complete picture of Earth's weather at one time.

**16** How many times the ISS circles our planet every day – once every 90 minutes.

**36,000 km** At this distance, a satellite can orbit the Earth at the same rate that the Earth spins. This makes it a geosynchronous satellite.

## How Slow Does it Go?

How far a satellite is from Earth determines how many orbits per day the satellite travels. Closer means that a satellite can go around the Earth many times – generally once every 99 minutes. Orbits further out take about 24 hours to complete one turn around the planet.

Credit: NASA



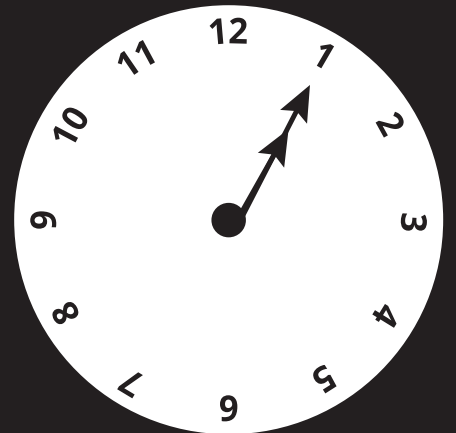
### Spot the ISS

At times, you can spot the International Space Station – a low-earth orbit satellite with astronauts onboard – in the skies above you. Check out [spotthestation.nasa.gov](http://spotthestation.nasa.gov) to learn when and how.

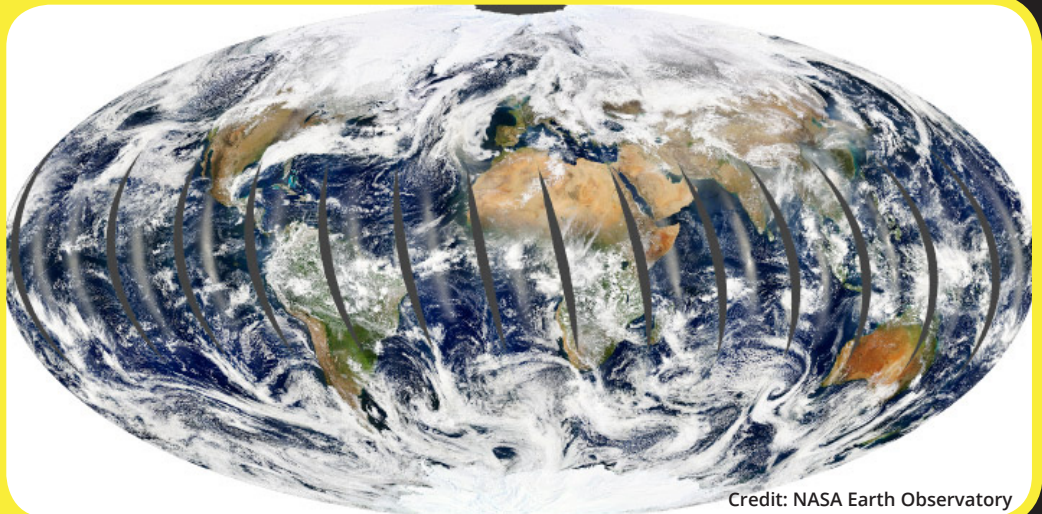
Astronauts working on the ISS view the Earth regularly and take photos of it. They get help watching our planet through several instruments pointed towards Earth. The ISS orbits the planet closer than most other low-Earth orbit satellites – at about 385 km (240 miles).

### As the Earth Turns

A satellite in Sun-synchronous orbit crosses the equator about every 99 minutes. This means it will pass over Kenya at 1:05 p.m., and then pass over Gabon (two time zones to the west) around the same time of day. This kind of orbit allows the satellite to gather images and measurements across the planet with the same lighting and timing. This is important for making global data sets because conditions are controlled. This means these conditions stay the same even though the location the satellite is imaging changes. This helps make more accurate measurements.



NASA's Aqua satellite collected the imagery to create this nearly complete picture of Earth's land, oceans, and clouds on March 16, 2009. The Aqua satellite follows a Sun-synchronous orbit.



Credit: NASA Earth Observatory

# DIY Science

## Orbital Distances

Answers to step 1:  
High-Earth orbit = 18 ft., Low-Earth orbit = 1 ft.

It can be difficult to imagine distances in space. Make this scale model to better understand where Earth's satellites hang out.

### Try It

- 1 Calculate a scale for your model. The Earth's radius at the equator is 6,378 kilometers (3,963 miles).

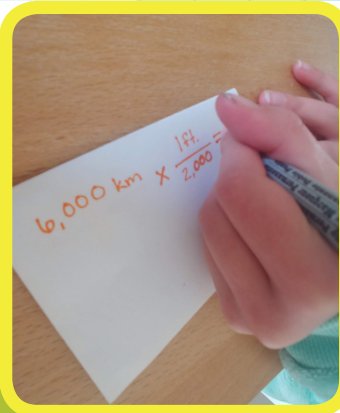
#### TIP

Round this number down to 6,000 km and use the following conversion factor to multiply.

$$1 \text{ ft} / 2,000 \text{ km}$$

For example, the Earth's **radius** is about 6,000 km, so:

$$6,000 \text{ km} \times \frac{1 \text{ ft}}{2,000 \text{ km}} = 3 \text{ ft}$$



- 2 Using the same math, figure out the orbital distances for:

- The outer edge of low-Earth orbit: 2,000 km
- The lowest edge of high-Earth (geosynchronous) orbit: 36,000 km
- The space between the outer edge of low-Earth orbit and high-Earth orbit is the mid-Earth orbit range.

### What you need:

- measuring tape or yardstick
- chalk or painter's tape
- an open area (inside or outside)
- a string
- 3 friends

- 3 Mark the radius of the Earth's surface on the ground by measuring 3 feet of string and using it like a compass to draw a circle with chalk. Do the same for the outer edge of low-Earth orbit and for high-Earth orbit (don't forget to add the 3 feet for Earth's radius each time).



### Vocabulary



**radius** – the distance from the center of a circle to the outside.

- 4 Get three friends to race in each orbit track (low-Earth orbit, mid-Earth orbit, and high-Earth orbit). Each friend will count how many laps they make in 1-minute. Set your timer and start the race. How many orbits did each friend make?

